

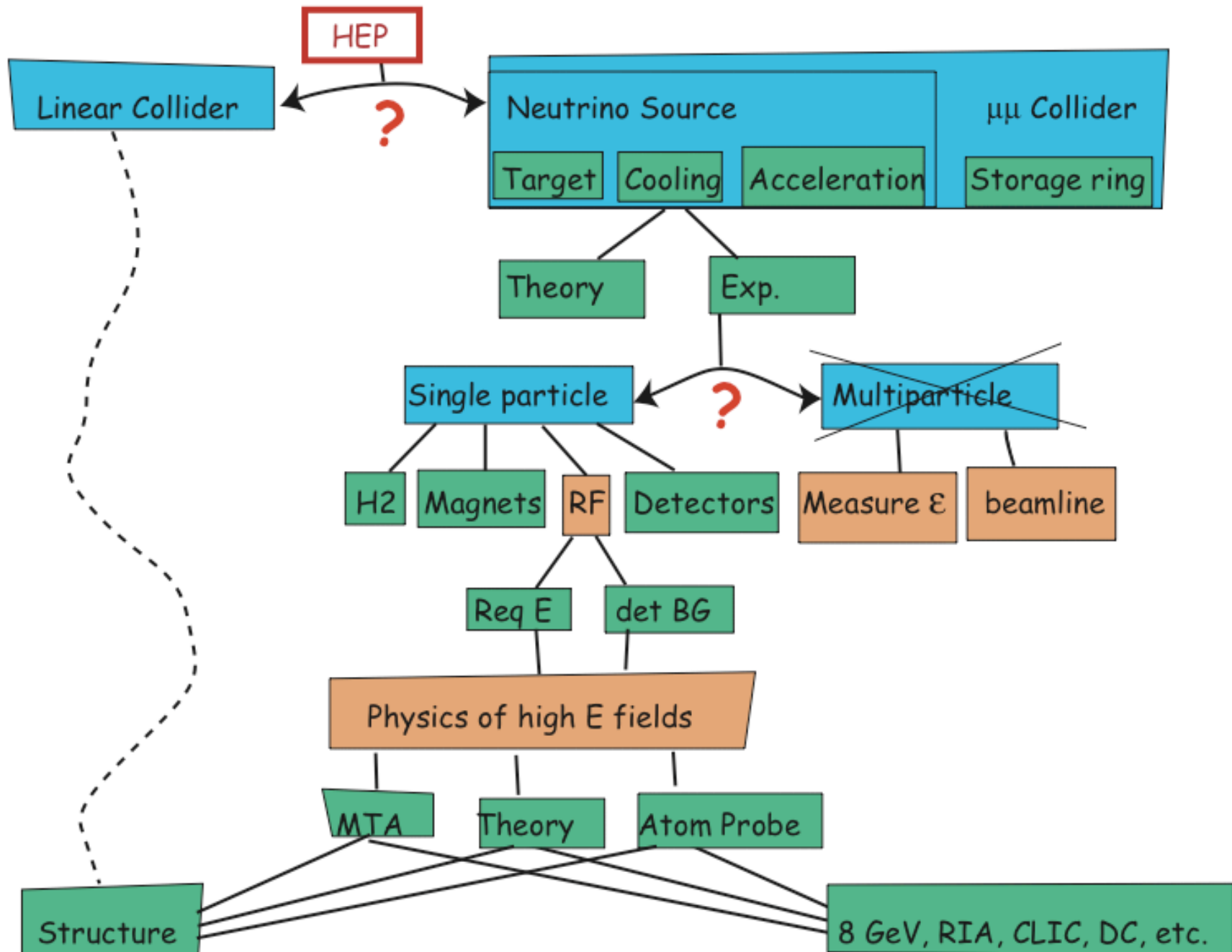
Recent Progress in RF

J. Norem
Argonne

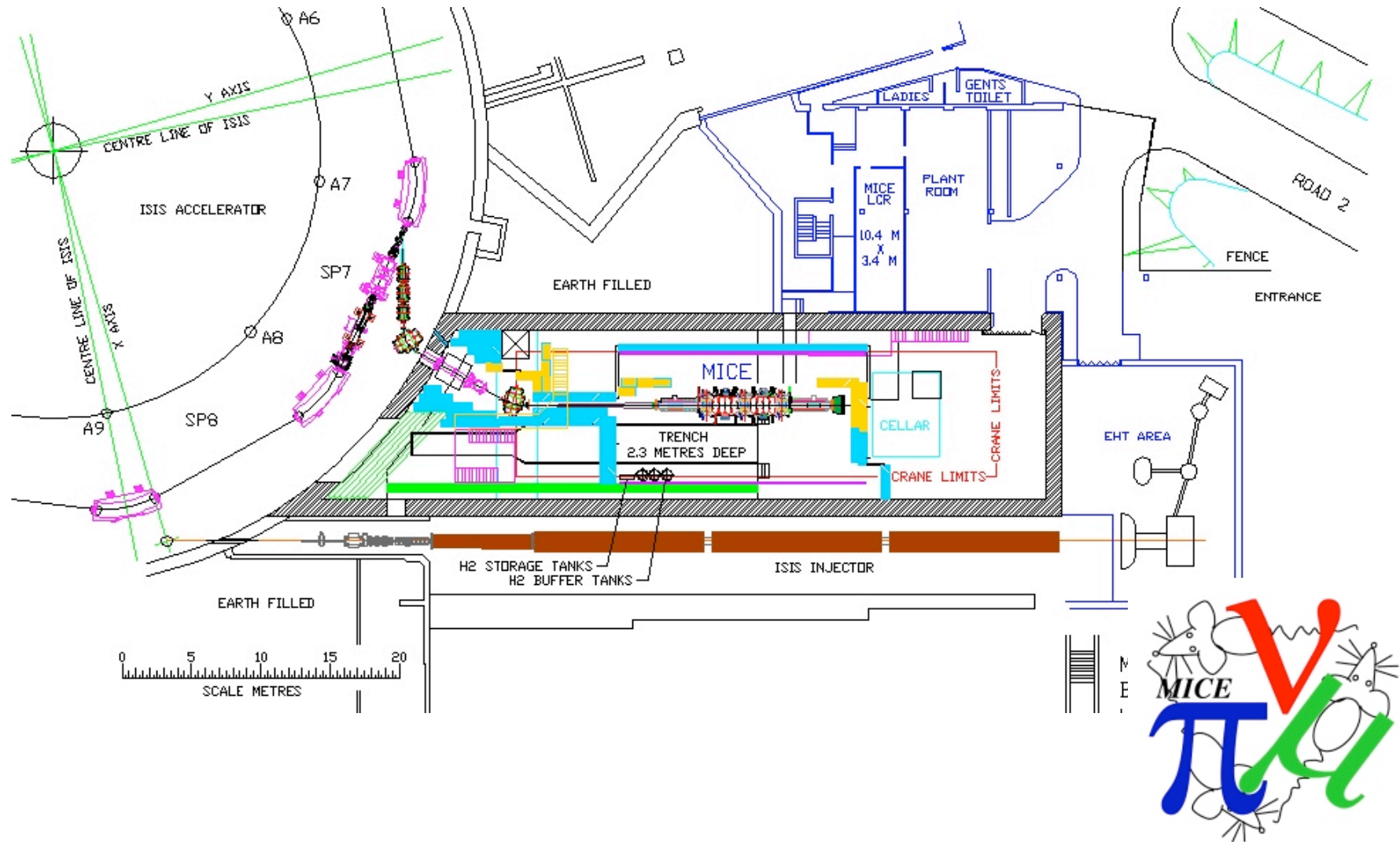
Muon Meeting
April 15, '05



RF in MICE is central and crucial



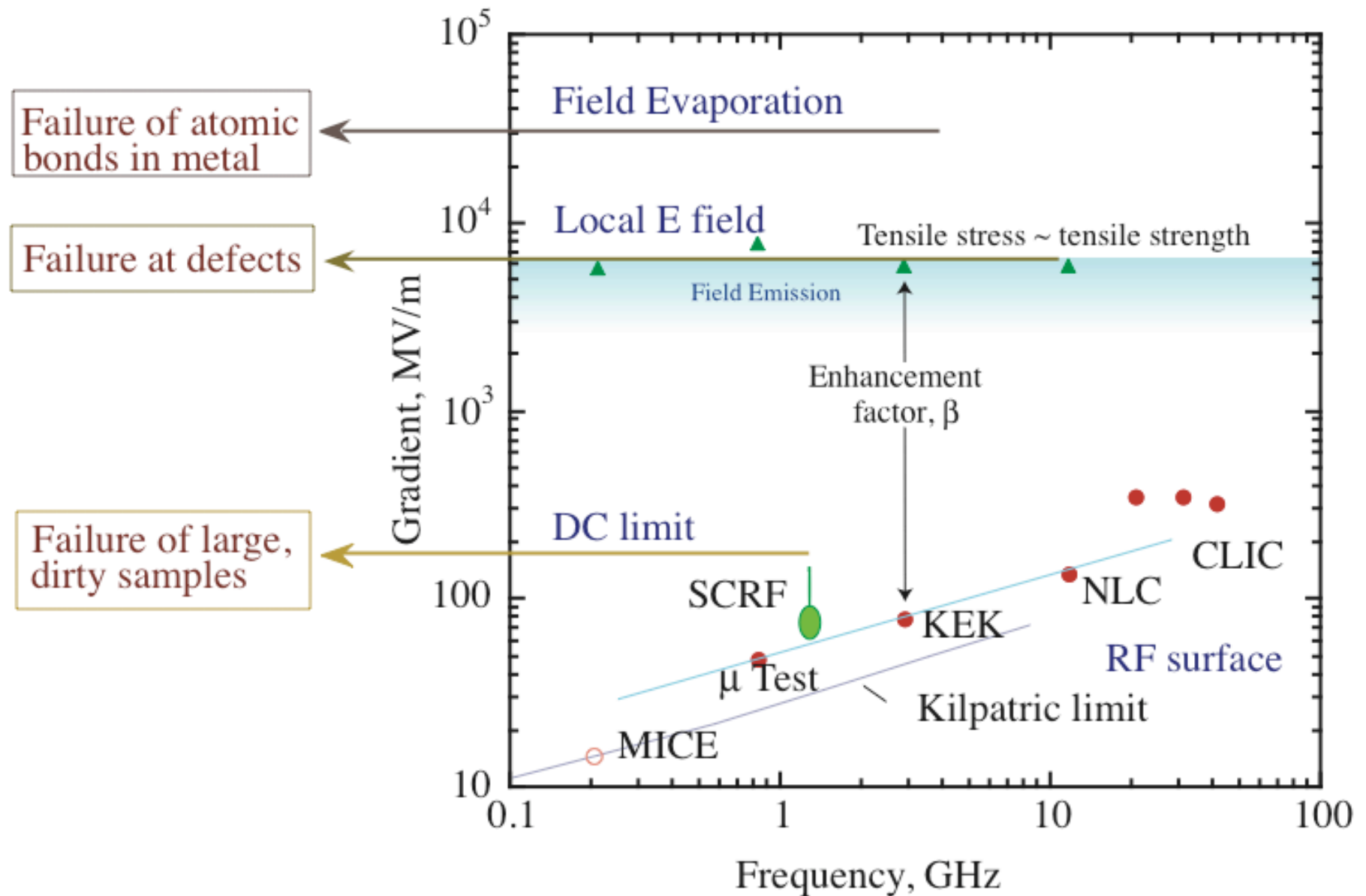
MICE is Approved, Funded* and construction is underway.



- Weak links: 1) We need to reach full E field with 5 T solenoid.
2) We need low backgrounds in spectrometers.

*not fully

High Gradients in Cavities



The Muon Collaboration rf program

Experimental

- Muon Test Area at Fermilab
Tests of cavities at 805 and 201 MHz with magnetic field
- Atom probe experiments at Northwestern
Materials studies relevant to Muon cooling, breakdown and SCRF
Prof. David Seidman, Jason Sebastian (Northwestern)
P. Bauer, C. Boffo (FNAL)

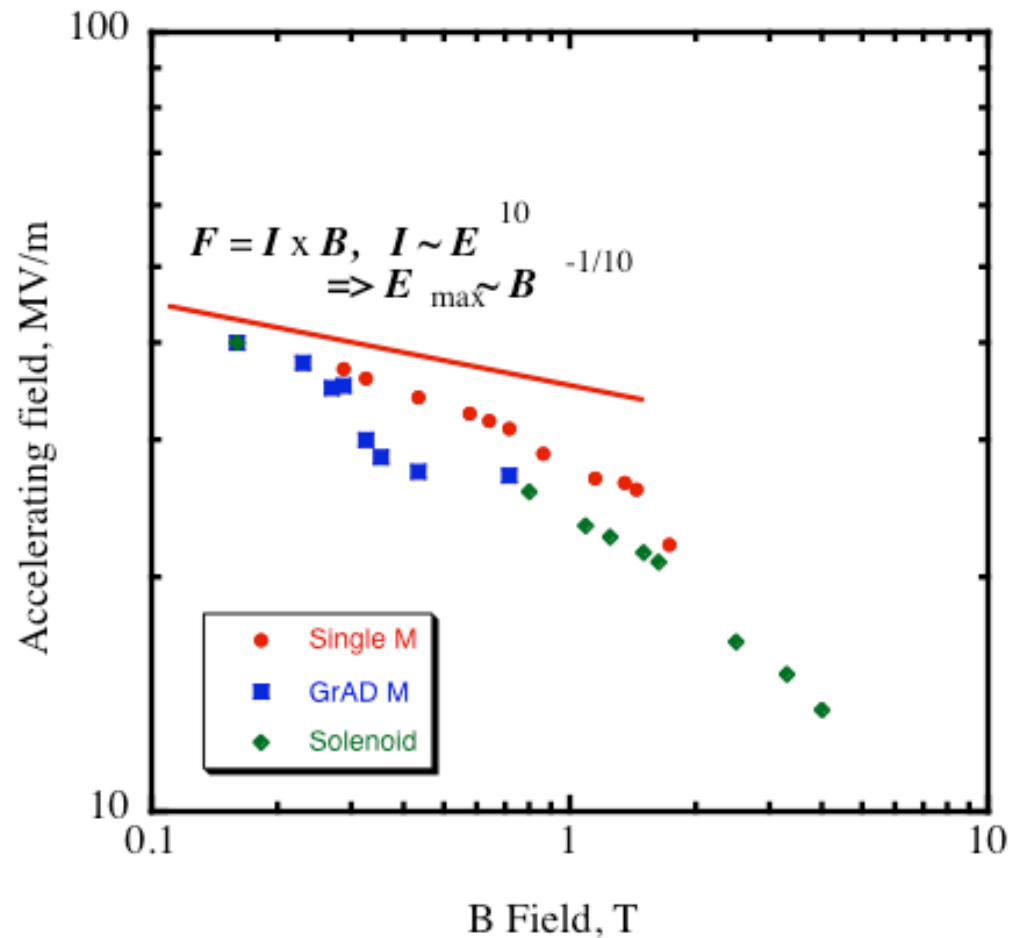
Modeling

- Model breakdown process, at Argonne.

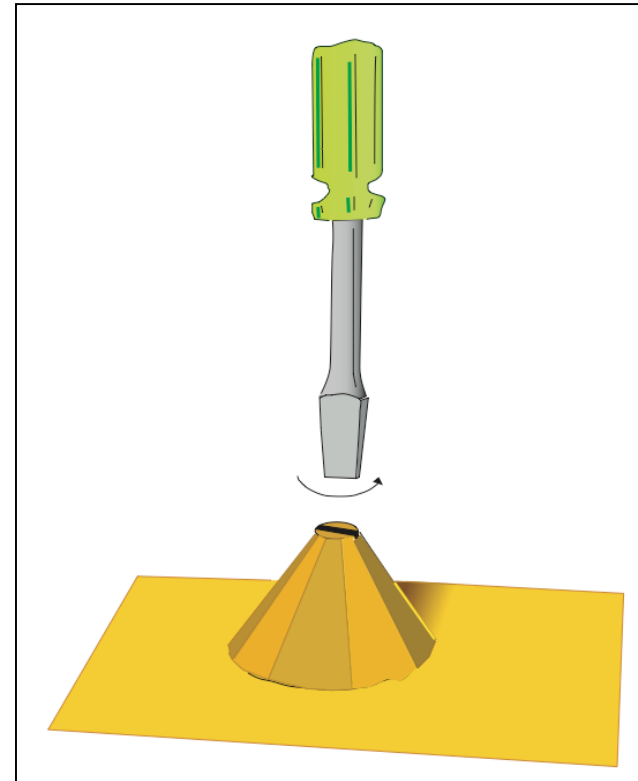
Magnetic field data is consistent with $\mathbf{j} \times \mathbf{B}$ effects.

- $\mathbf{j} \times \mathbf{B}$ forces are driven by field emission currents in the emitter.

The data



The model



Muon Test Area: RF Tests

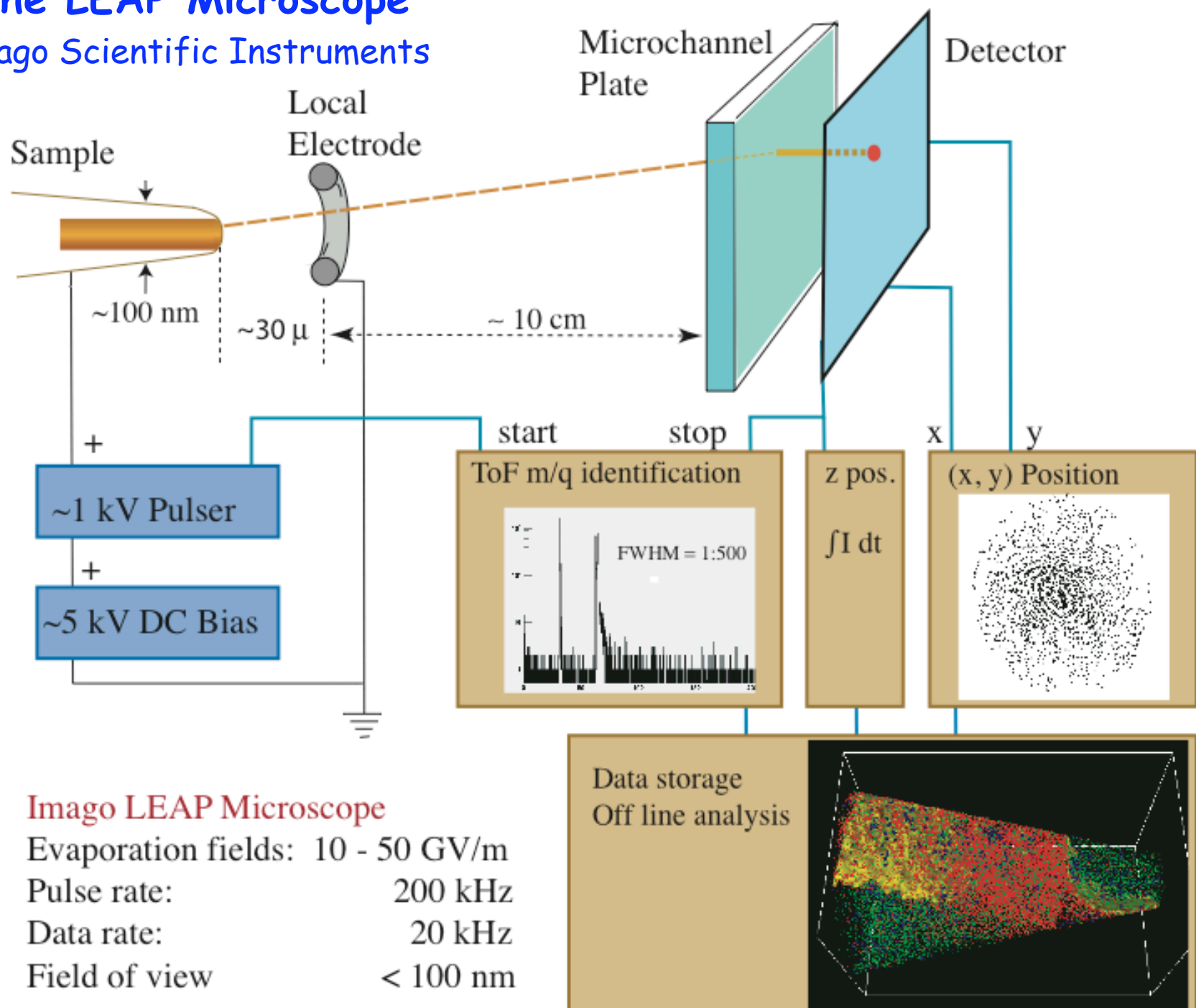


- Cabling is almost complete.
- Tests of 805 and 201 MHz windows
magnetic field effects
coatings, high pressure



The LEAP Microscope

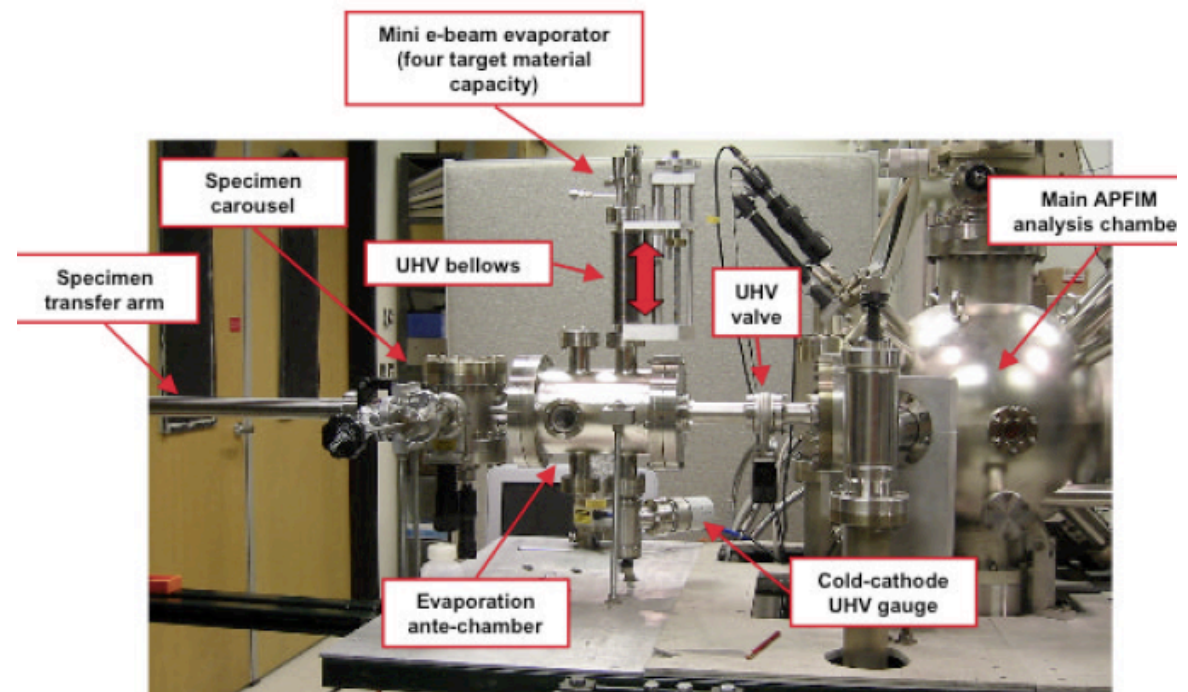
Imago Scientific Instruments



Atom Probe: Coating Tests

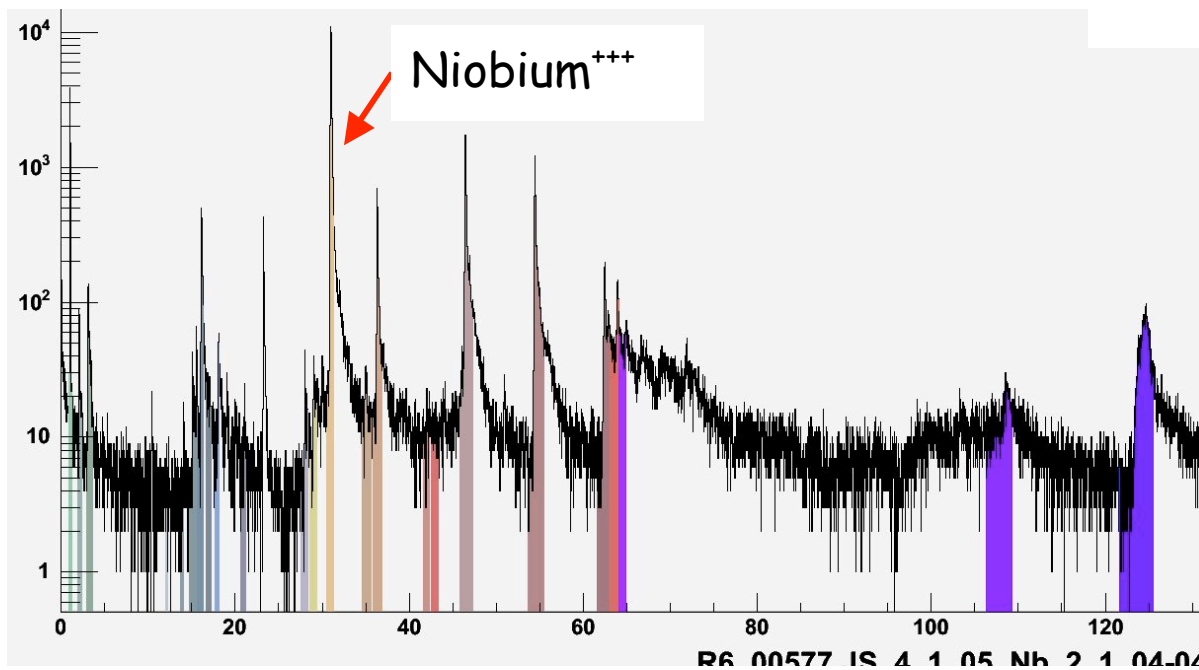
Typical experimental sequence (simplified)

1. Move tip into main chamber
2. Develop tip to smooth end-form via field-evaporation
 - Positive high voltage
3. Measure I-E response (field-emission; Fowler-Nordheim plot)
 - Negative high voltage
4. Move tip into evaporation ante-chamber
5. Evaporate onto developed tip surface
 - Other tip treatments
6. Move tip back into main chamber
7. Re-measure I-E response (field-emission; Fowler-Nordheim plot)
 - Negative high voltage
8. Remove coating via field evaporation
 - Positive high voltage
 - Information about coating adhesion, bonding, interdiffusion, etc.

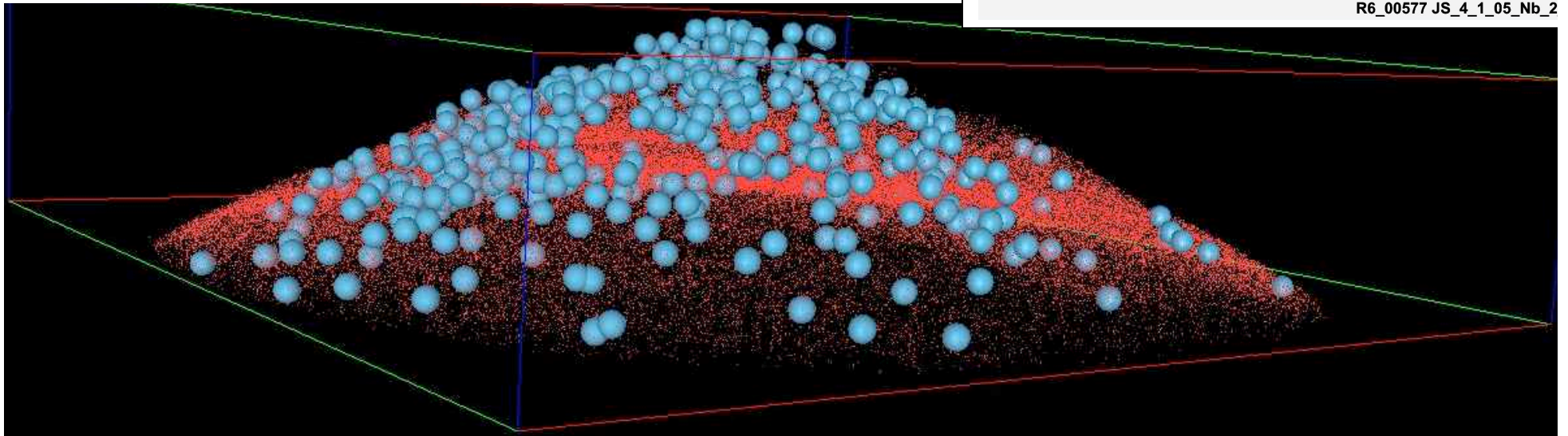
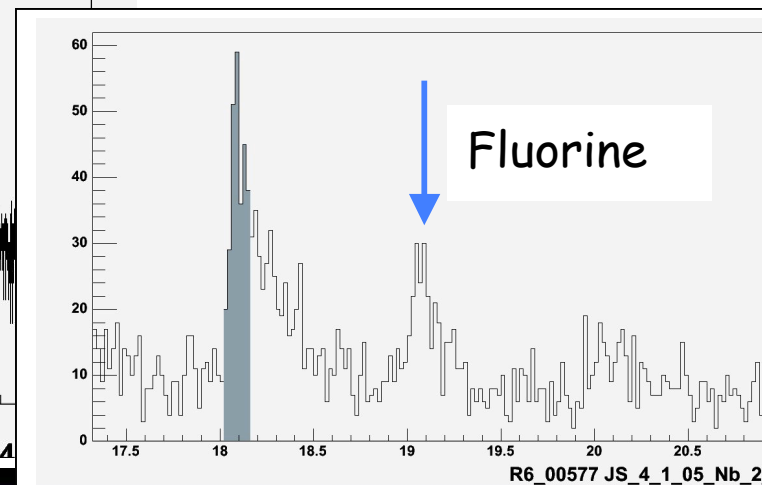


Atom Probe Data: Fluorine Contamination on Niobium

- Ions are identified by time of flight (over ~10 cm).

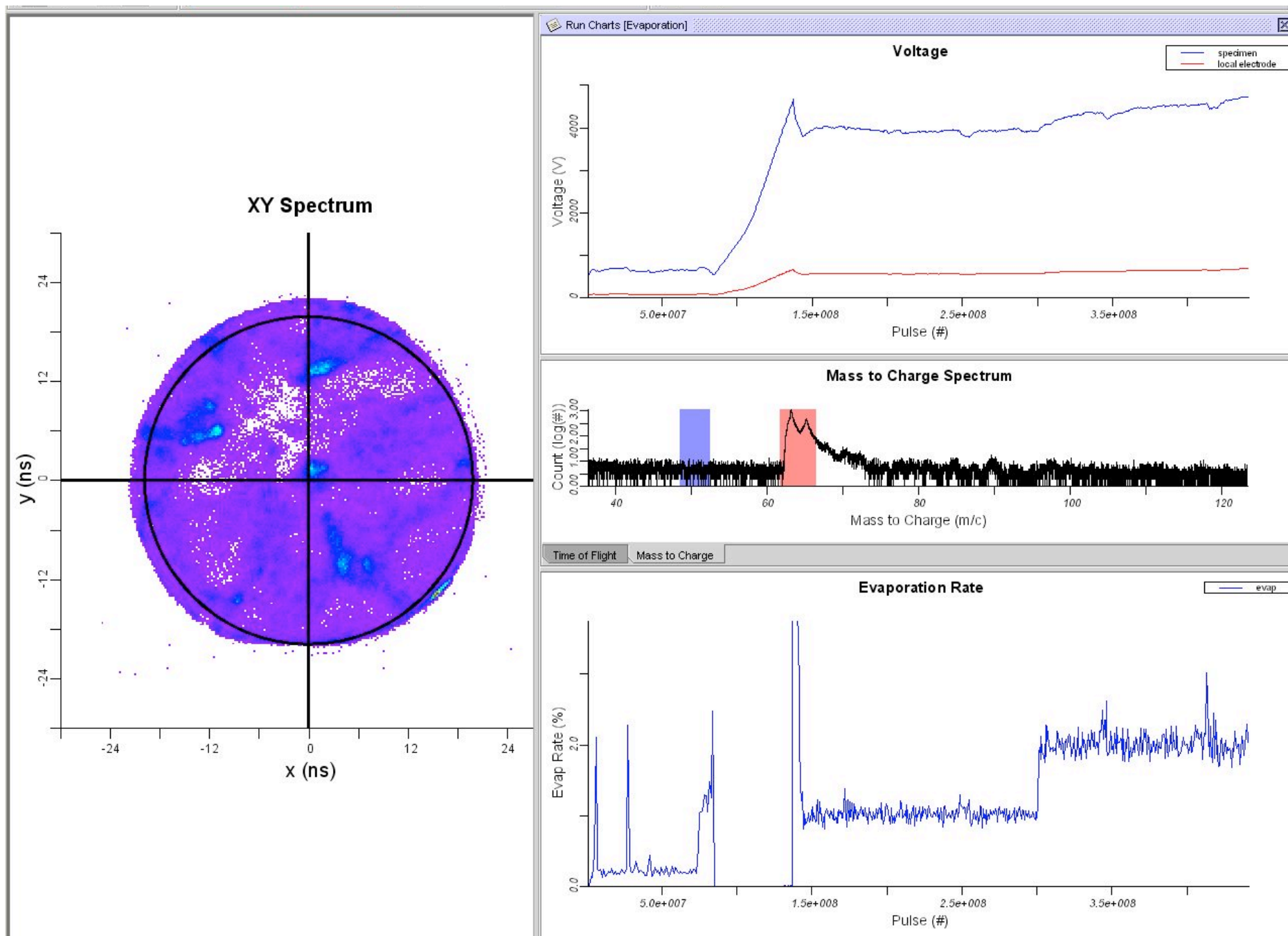


w/ P. Bauer, C. Boffo, FNAL

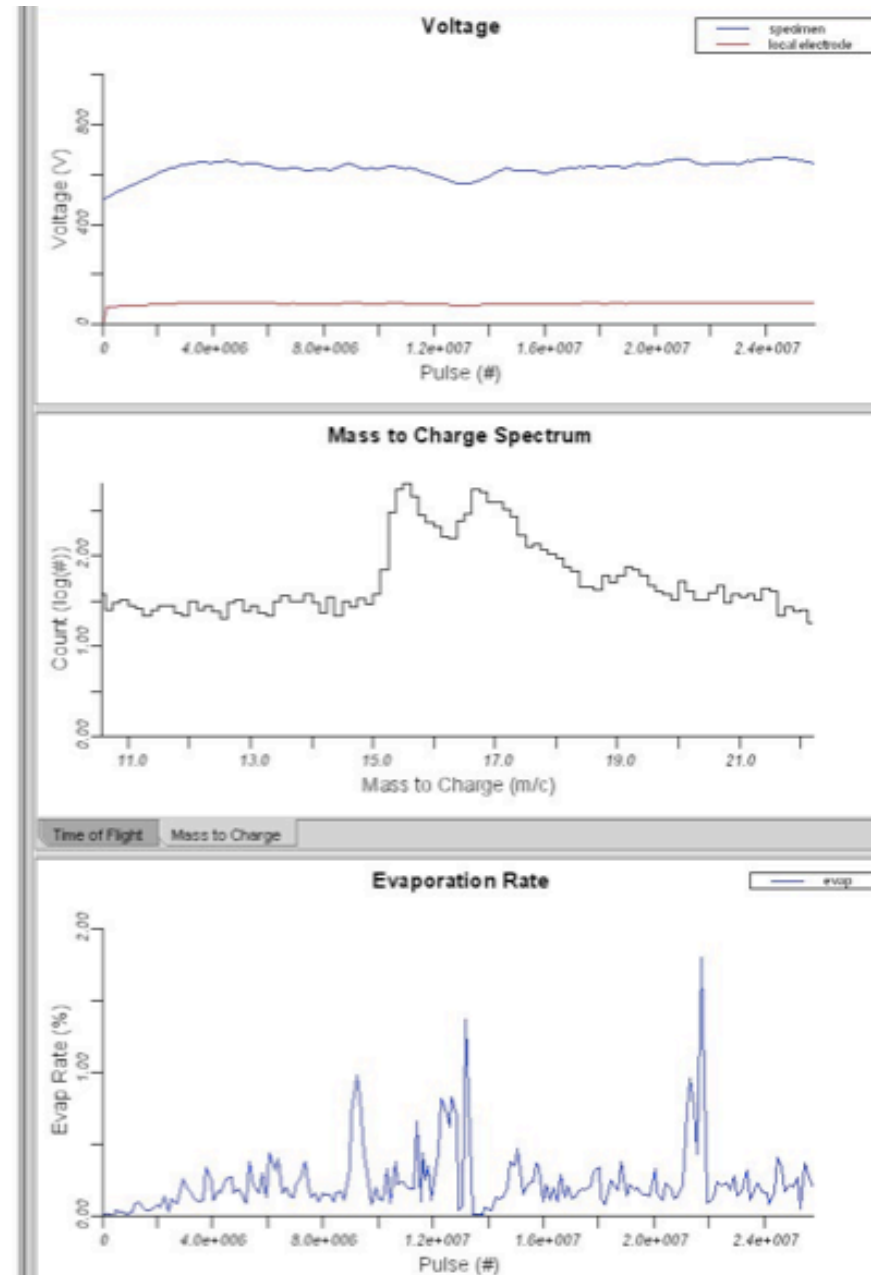
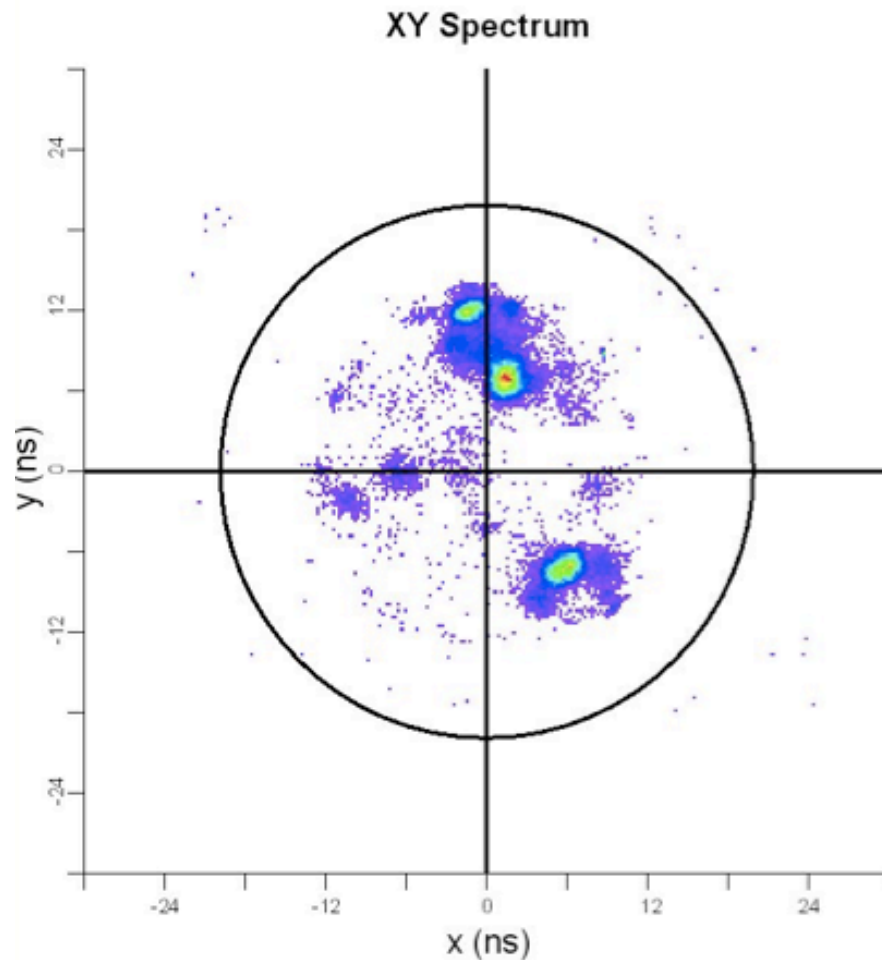


Atom Probe Data: Room Temp. Cu

(Very preliminary)



More Data: Are these Breakdown Triggers?



Summary

- We are getting atom probe data relevant to:
 - Breakdown
 - Surface microstructure
 - Surface contamination (oxides etc.)
- We see “flashes” at about the surface fields we might expect rf breakdown.
- After the surface “cleans up”, the tips support much higher fields.
- We don't understand all of this yet.